MENTAL REPRESENTATIONS
The Ingredients of Thought

- Our thinking capacity is based largely on our ability to manipulate mental representations, or “the ingredients of thought.”

- The three major thinking processes which do this are:
  - REASONING
  - PROBLEM-SOLVING
  - DECISION-MAKING
MENTAL REPRESENTATIONS

Thinking Strategies: REASONING

- REASONING  process of generating and evaluating arguments, then drawing conclusions

- FORMAL REASONING (Deductive Reasoning)  process of following rigorous procedures to reach valid (correct) conclusions
  
  - takes general rule and uses it to draw conclusions about specific cases
  
  - sometimes relies on the application of mathematical formulas to existing data in order to generate new data

  - **Algorithms**  systematic methods that *always* produce a correct solution to a problem, if a problem exists

  - **Rules of Logic**  sets of statements (in the form of “if-then” statements) that provide a formula for drawing valid conclusions about the world
MENTAL REPRESENTATIONS
Thinking Strategies: REASONING

- More on FORMAL REASONING: **Syllogisms**
  - rules of logic evolved into system for drawing correct conclusions
  - based on set of statements called premises
  - **Syllogisms** logical arguments containing two or more premises and a conclusion
    (inference based on premises and rules of logic)
  - e.g.,
    - **Premise 1:** This class is open only to seniors.
    - **Premise 2:** I am not a senior.
    - **Conclusion:** I cannot take this class.
MENTAL REPRESENTATIONS

Thinking Strategies: REASONING

- More on FORMAL REASONING: Syllogisms
  - validity depends both on accuracy of premises AND ability to draw correct inferences from them
  - **reasoning errors** can lead to later problems in problem-solving and decision-making
    - **Belief Bias** when people believe bias based on what they already know or wish; may cause someone to accept illogical conclusions
    - **Confirmation Bias** tendency to seek evidence and reach conclusions consistent with existing beliefs
    - **Limits on Working Memory** if amount of material to be mentally manipulated exceeds the capacity of STM, logical errors can result
MENTAL REPRESENTATIONS
Thinking Strategies: REASONING

○ Reviewing FORMAL REASONING (with a partner)
  ○ Create an example of an algorithm to find a particular item in a department store.
  ○ Create a syllogism with at least two premises and a logical conclusion.
  ○ Create a syllogism with belief bias.
  ○ Create a syllogism based on confirmation bias.
MENTAL REPRESENTATIONS

Thinking Strategies: REASONING

- **INFORMAL REASONING** (Inductive Reasoning) process of evaluating a conclusion, theory, or course of action based on *believability* of evidence
  - uses specific situations, results, or experiences to draw general conclusions
  - used by jurors in deciding guilt or innocence of accused
  - used by psychologists when conducting experiments
  - no foolproof methods for informal reasoning
  - uses mental “shortcuts” or “rules of thumb” called **heuristics**
    - easy to use and frequently work well
    - can bias cognitive processes and cause errors because they lack defined set of rules of algorithms
  - three heuristics (each potentially problematic) people intuitively use to make judgements: anchoring heuristics, representativeness heuristics, & availability heuristics
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Thinking Strategies: REASONING

- The Anchoring Heuristic (or Adjustment Heuristic)
  - rule of thumb with starting or reference point that adjusts to accommodate information
  - allows us to make snap judgments based on beginning frame of reference
  - we adjust to accommodate new info but initial judgment/starting point (the "anchor") keeps our adjustments from moving too far
  - may bias our judgments

  e.g., ___________________________________________________________________

You bet $20 that you can beat your buddy playing a single hand of poker because you are overconfident in your own abilities. You lose the hand but blame it on bad luck. Just to be safe, though, you only bet $10 the next hand.
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Thinking Strategies: REASONING

- The Representativeness Heuristic
  - rule of thumb relying on how well a situation matches a generalization or prototype we have about an established concept rather than numerical probabilities
  - used to help make quick decisions
  - can lead to errors such as stereotyping/misrepresentation of certain segment of population
  - people tend to make judgments based on how well a particular description fits the general population
  - e.g., ___________________________________________________________________

You ask a senior to help you with your math homework because you think they are smarter than you because they are older and have already had the math class you are currently taking.
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Thinking Strategies: REASONING

○ The Availability Heuristic

○ rule of thumb that relies on most easily accessible information known to person to assist in problem-solving

○ involves judging likelihood of event or correctness of hypothesis by how easily hypothesis or examples of event can be brought to mind

○ people tend to choose alternative most mentally “available” but not always most accurate.

○ e.g., __________________________________________________________________________

You just recently heard about a mall shooting. So you decide to not go shopping at the mall because you think it’s not safe.

more on heuristics HERE
MENTAL REPRESENTATIONS
Thinking Strategies: PROBLEM-SOLVING

- What IS a problem?
  - Simply put, you have a problem if where you are is not where you want to be!

- What is the most effective approach to solving a problem?
  - CIRCLE OF THOUGHT--identify problem in elaboration stage; formulate plan for solving it; execute plan; then evaluate results to make sure problem has been solved

- Unfortunately, people’s problem-solving efforts are not always so systematic.

- Other problem-solving strategies include:
  - MEANS-END ANALYSIS
  - WORKING BACKWARD
  - ANALOGIES
  - INCUBATION
  - INSIGHT
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Thinking Strategies: PROBLEM-SOLVING

- MEANS-END ANALYSIS (also called DECOMPOSITION)
  - relies on identification of a final goal AND steps needed to achieve that goal
  - final goal identified FIRST, then subgoals or behaviors determined necessary for achievement of final goal
  - involves continuously asking yourself where you are in relation to final goal and then deciding on means to get one step closer to it
  - after subgoal reached, re-evaluation of each subsequent goal needed to stay on track
  - basically involves breaking down problem into smaller, more manageable sub-problems
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Thinking Strategies: PROBLEM-SOLVING

○ WORKING BACKWARD
  ○ “working backward” from end goal
  ○ helps avoid getting side-tracked with dead-end choices on way to goal
  ○ runs counter to way we have learned to think

○ ANALOGIES
  ○ involves finding similarities between current problem and prior problems
  ○ allows application of previously successful techniques on current problems
  ○ may limit or obstruct individual’s ability to solve problem if techniques being considered don’t really apply to current problem
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Thinking Strategies: PROBLEM-SOLVING

○ INCUBATION
  ○ stepping back from problem to allow problem to solve itself
  ○ often helpful to step back and stop thinking about problem for a while
  ○ time away from problem allows for fresh perspective to emerge and possibly better solution

○ INSIGHT (also known as the “EUREKA EFFECT” or the “AHA MOMENT”)
  ○ sudden realization of solution to problem that often occurs during incubation
  ○ useful when faced with problem that appears to have no solution
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OBSTACLES TO PROBLEM-SOLVING

- **Multiple Hypotheses**
  - due to limited working memory, people have difficulty entertaining more than two or three hypotheses or probable solutions at one time
  - additionally, heuristics may lead people to choose solution that most easily comes to mind and seems to fit circumstances rather than consider a correct one

- **Mental Sets**
  - an individual’s mind is “set” on or has tendency to approach new problems with successful past strategies, even when better alternatives should be obvious
  - may also restrict perception of problem itself
  - limit our ability to “think outside the box” because we are locked into previously successful strategies
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OBSTACLES TO PROBLEM-SOLVING

- Functional Fixedness
  - inability to see object as being useful for anything other than its intended purpose
  - prevents some people from solving problems otherwise easily been solved with a little creativity

- Ignoring Negative Evidence
  - absence of symptoms or events can provide important evidence for or against hypothesis
  - people less likely to notice when symptoms or events that should be present are NOT there

- Confirmation Bias
  - tendency to confirm--rather than refute--a chosen hypothesis or belief *even if strong evidence against it*
  - a form of anchoring heuristic familiar to just about everyone because we all tend to ignore info contrary to our own personal beliefs and accept information confirming those beliefs
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Thinking Strategies: DECISION MAKING

- We make decisions every day.
- Decisions made when the outcome is uncertain are called risky decisions.
- There are a number of strategies that help us deal with this kind of decision making.

EVALUATING OPTIONS
COMPARING ATTRIBUTES
ESTIMATING PROBABILITIES
MENTAL REPRESENTATIONS
Thinking Strategies: DECISION MAKING

- EVALUATING OPTIONS
  - *multi-attribute decisions* involve weighing options having both positive and negative features or *attributes*
  - decisions complicated by difficulties in comparing attributes and in estimating probabilities of various outcomes.
  - e.g., ____________________________________________________________
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Thinking Strategies: DECISION MAKING

○ COMPARING ATTRIBUTES

○ people tend to focus on the one feature or attribute in a decision that is important to them

○ may be impossible to compare the attributes of options in terms of money or other objective criteria in many important decisions

○ UTILITY  term used to describe subjective, personal value of each attribute

○ utility seen as a measurement of satisfaction received by choosing a particular option

○ in decision-making, goal is to maximize utility (satisfaction) and minimize potential dissatisfaction

○ e.g., ____________________________________________________________________
MENTAL REPRESENTATIONS
Thinking Strategies: DECISION MAKING

- ESTIMATING PROBABILITIES
  - to make a good decision, take into account not only attributes of options, but also probabilities and risks of their possible outcomes
  - best decision maximizes EXPECTED VALUE--the average benefit a person could expect to receive if decision repeated on several occasions
  - formula for expected value is (probability of gain X size of gain) minus (probability of loss X size of loss)
  - e.g., ___________________________
MENTAL REPRESENTATIONS

BIASES & FLAWS IN DECISION MAKING

1. Positive utilities are NOT mirror images of negative utilities. When people feel worse about losing a certain amount than they feel good about gaining the same amount, this is called loss aversion. This occurs when people make decisions with the intent of avoiding negative outcomes rather than achieving positive ones.

   e.g., _________________________________________________________________

2. Utility of a specific gain depends on your starting point. This brings to mind Weber’s law, and how much a difference in value means to you depends on how much you already have. In other words, the more you have, the less it means.

   e.g., _________________________________________________________________

3. Another flaw in decision making is people’s tendency to be unrealistically confident in their accuracy of their predicted outcomes.

   e.g., _________________________________________________________________
4. People are also biased in how they perceive probability.
   - There is a tendency to overestimate rare probabilities and underestimate frequent ones.
   - This tendency is amplified by the availability heuristic, vivid memories of rare events, and intense publicity given such events.
   - The gambler’s fallacy is a belief that future events in a random process will be changed by past events or influenced by preceding behaviors. This may lead to:
     - the persistence of behaviors that are only rewarded now and then.
     - decisions being made that often lead to unwanted outcomes.
   - e.g., _________________________________________________________________

5. Another influence on the decision making process is the framing effect--influencing the decision by altering the words used in describing the decision.
   - The way a question is worded, or “framed,” can influence and bias a person’s decision.
   - e.g., _________________________________________________________________